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ECOLOGICAL RESEARCH PROGRAM

BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

# *What are ecosystem services and how might they be evaluated?*

By

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National Program Director for Ecology

September 26, 2007

U.S. Environmental Protection Agency
Office of Research and Development

# Living Beyond Our Means

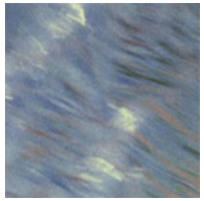



# Natural Assets and Human Well-being

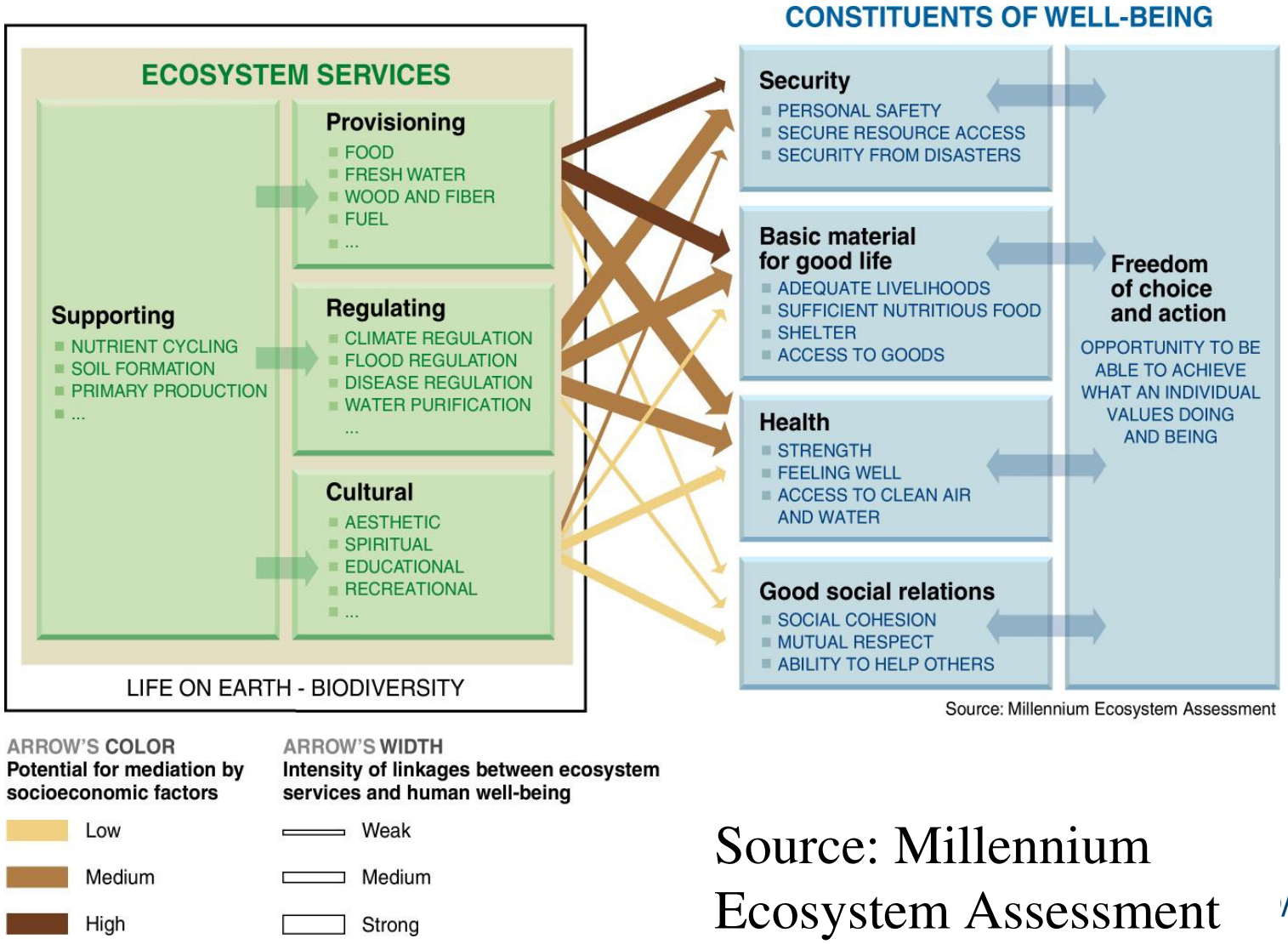
*Statement from the Board*

# *Millennium Ecosystem Assessment*





- Largest assessment ever undertaken of the health of ecosystems and the consequences of ecosystem change for human well-being
  - *Prepared by 1360 experts from 95 countries; extensive peer review*
  - *Consensus of the world's scientists*
- Designed to meet needs of decision-makers among government, business, civil society
  - *Information requested through 4 international conventions*




Source: Millennium Ecosystem Assessment /2008

# *Key Finding (MEA)*

- Even today's technology and knowledge can reduce considerably the human impact on ecosystems. They are unlikely to be deployed fully, however, until ecosystem services cease to be perceived as free and limitless, and their full value is taken into account.

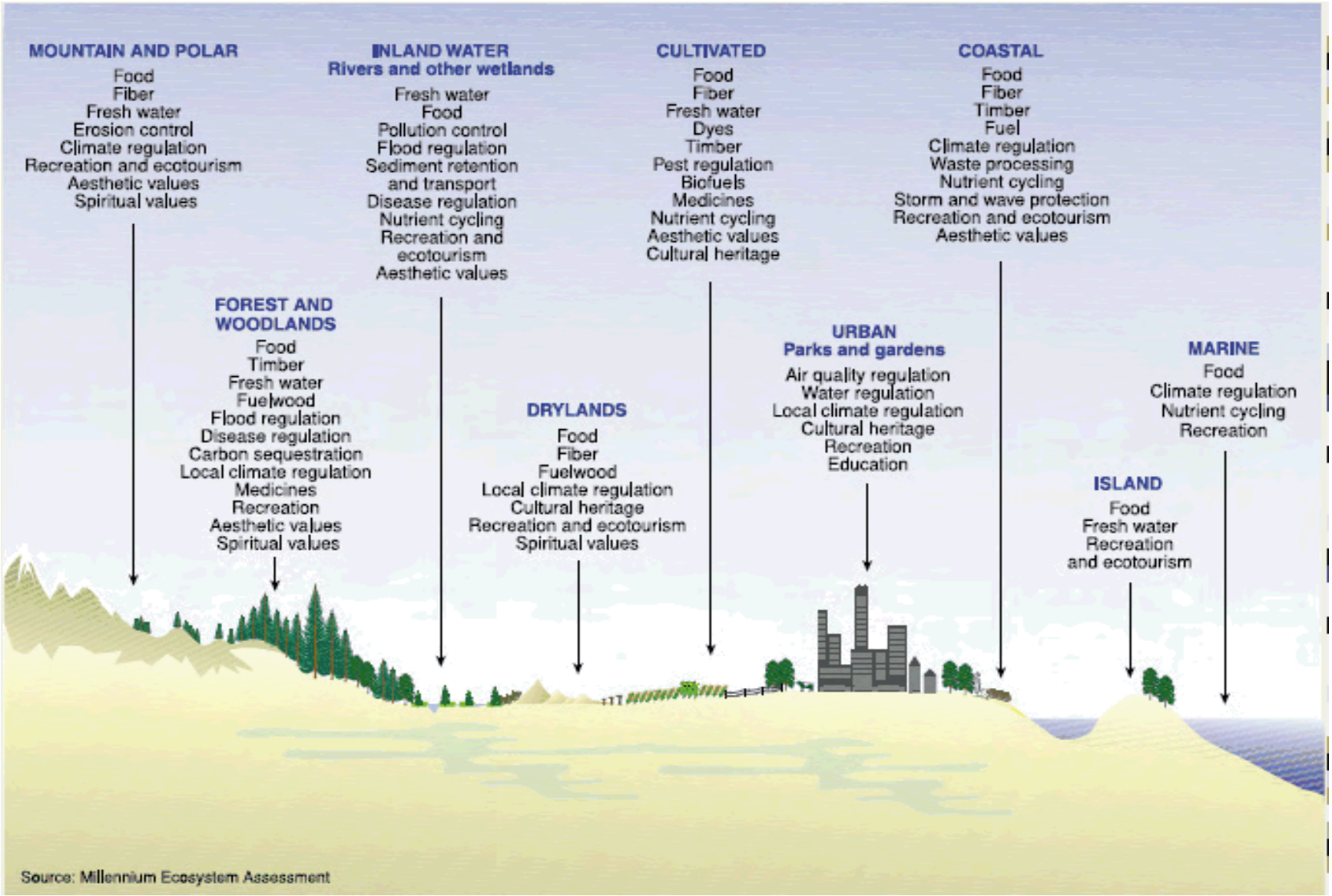
# Drivers Beyond MEA

- An Executive Order that has been without ecological input *(Executive Order 12866, 9/30/93*).
  - (*http://www.epa.gov/regulations/follow.htm*)
- The other drivers include:
  - The administrators charge to advance environmental protection while maintaining our economic competitiveness,
  - The increased emphasis on environmental stewardship and information to make better decisions without regulation,
  - Sustainability of ecosystems/services as an Agency theme, and
  - Urban sprawl and rapid loss of natural areas


SUSTAINABLE HUMAN WELLBEING
built capital
social capital
natural capital
human capital
Image courtesy of the
Gund Institute for Ecological Economics
at the University of Vermont

# Challenge to Ecologists

**To transform the way we understand and respond to environmental issues by making clear the ways in which our choices affect the type, quality and magnitude of the services we receive from ecosystems -- such as clean air, clean water, productive soils and generation of food and fiber.**


MOUNTAIN AND POLAR
Food
Fiber
Fresh water
Erosion control
Climate regulation
Recreation and ecotourism
Aesthetic values
Spiritual values
INLAND WATER
Rivers and other wetlands
Fresh water
Food
Pollution control
Flood regulation
Sediment retention and transport
Disease regulation
Nutrient cycling
Recreation and ecotourism
Aesthetic values
CULTIVATED
Food
Fiber
Fresh water
Dyes
Timber
Pest regulation
Biofuels
Medicines
Nutrient cycling
Aesthetic values
Cultural heritage
COASTAL
Food
Fiber
Timber
Fuel
Climate regulation
Waste processing
Nutrient cycling
Storm and wave protection
Recreation and ecotourism
Aesthetic values
FOREST AND WOODLANDS
Food
Timber
Fresh water
Fuelwood
Flood regulation
Disease regulation
Carbon sequestration
Local climate regulation
Medicines
Recreation
Aesthetic values
Spiritual values
DRYLANDS
Food
Fiber
Fuelwood
Local climate regulation
Cultural heritage
Recreation and ecotourism
Spiritual values
URBAN
Parks and gardens
Air quality regulation
Water regulation
Local climate regulation
Cultural heritage
Recreation
Education
MARINE
Food
Climate regulation
Nutrient cycling
Recreation
ISLAND
Food
Fresh water
Recreation and ecotourism
Source: Millennium Ecosystem Assessment

# *Terms*

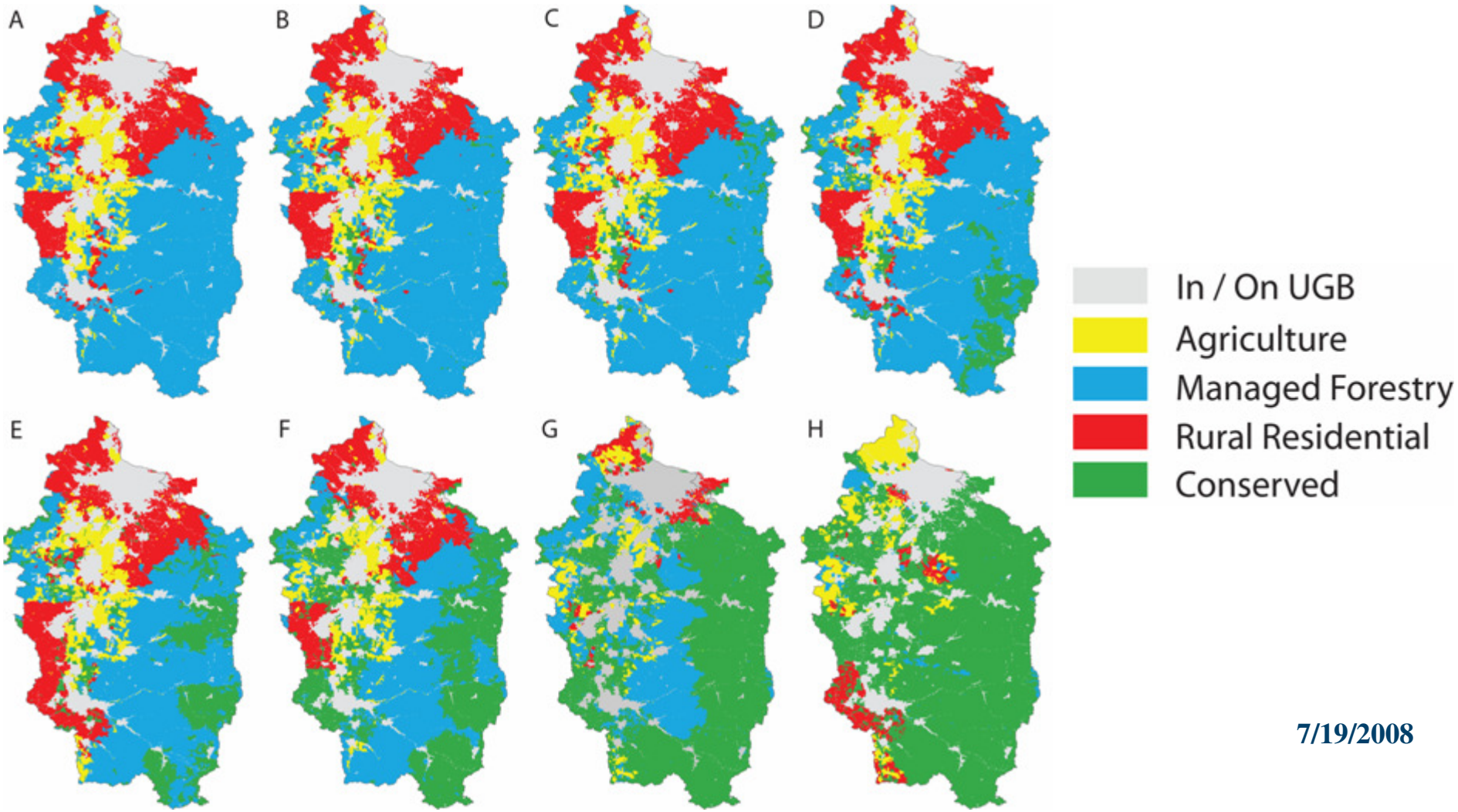
- **Ecosystem Services**
  - ***the current and future outputs of functioning, complex ecological systems that are enjoyed, consumed, or used by humans and that support their well-being, either directly or indirectly.***

- **Ecosystem Service Districts**
  - **a spatial boundary that delimits a core geographic area for the purpose of efficient, simultaneous management of multiple ecosystem services.**

Note that this boundary is not likely to coincide with watershed or municipal boundaries, but rather would be configured to address multiple services desired for an area.

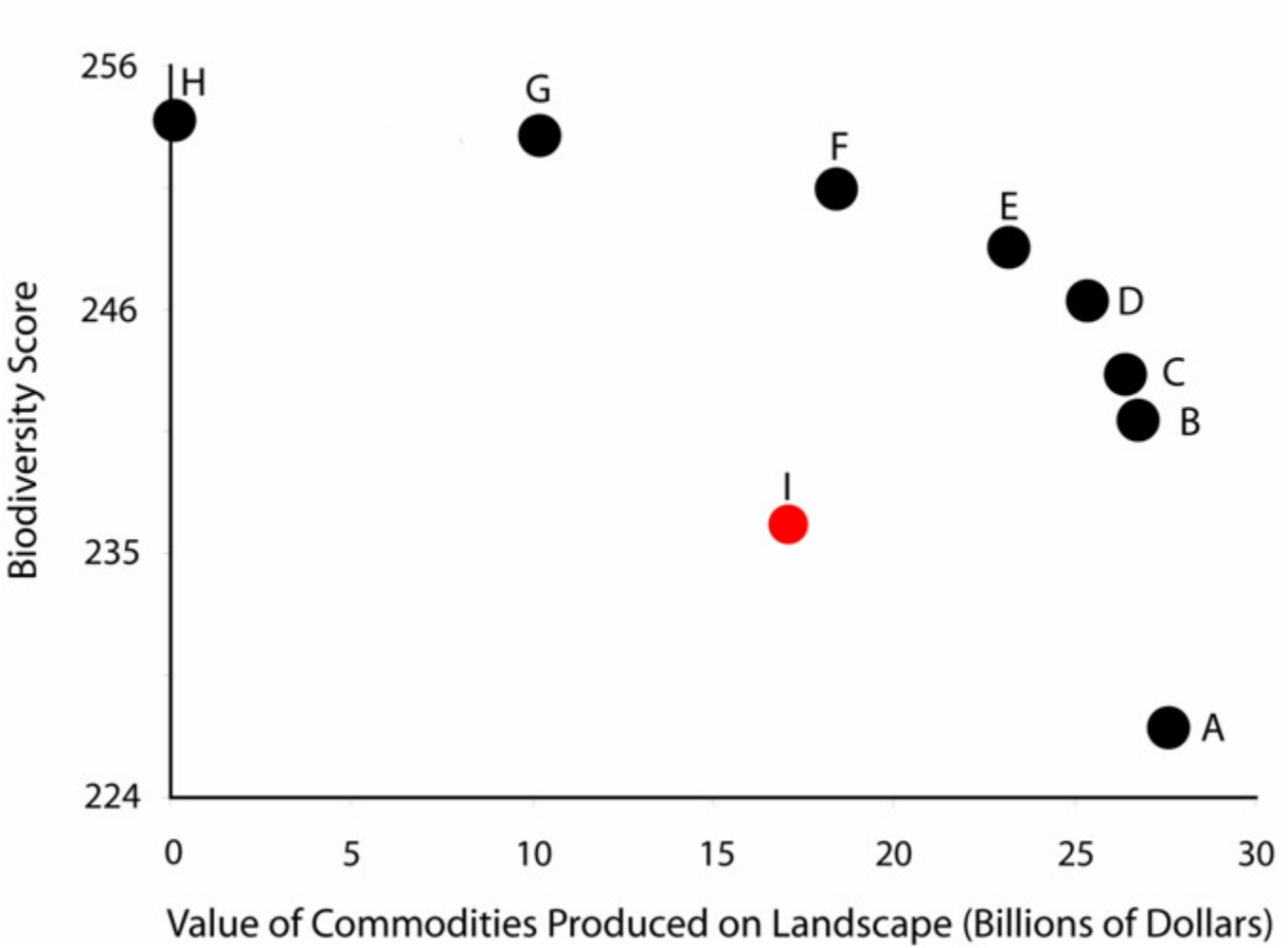

**Willamette River, Oregon**

# Compare scenarios

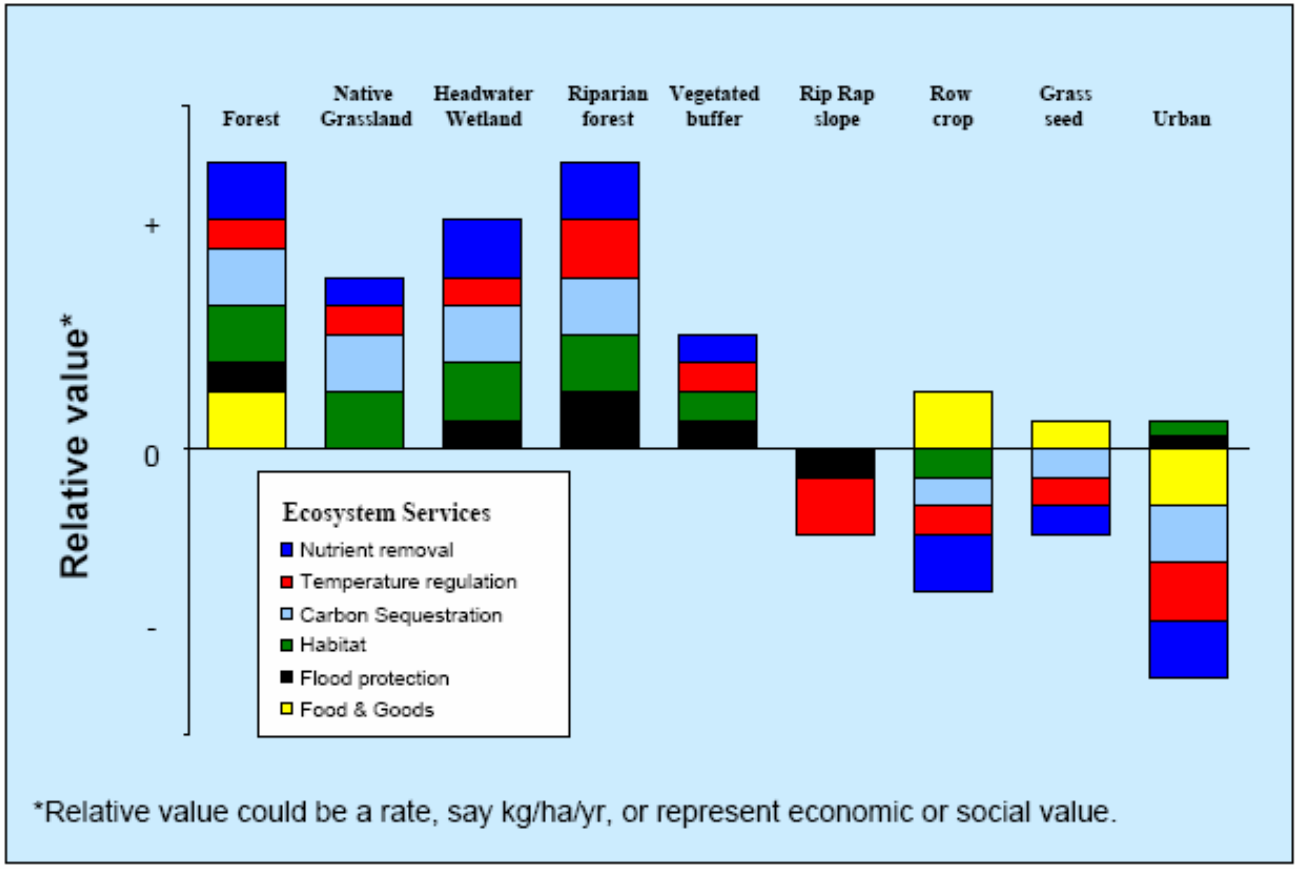


# Willamette Valley, Oregon

## *Compare scenarios*



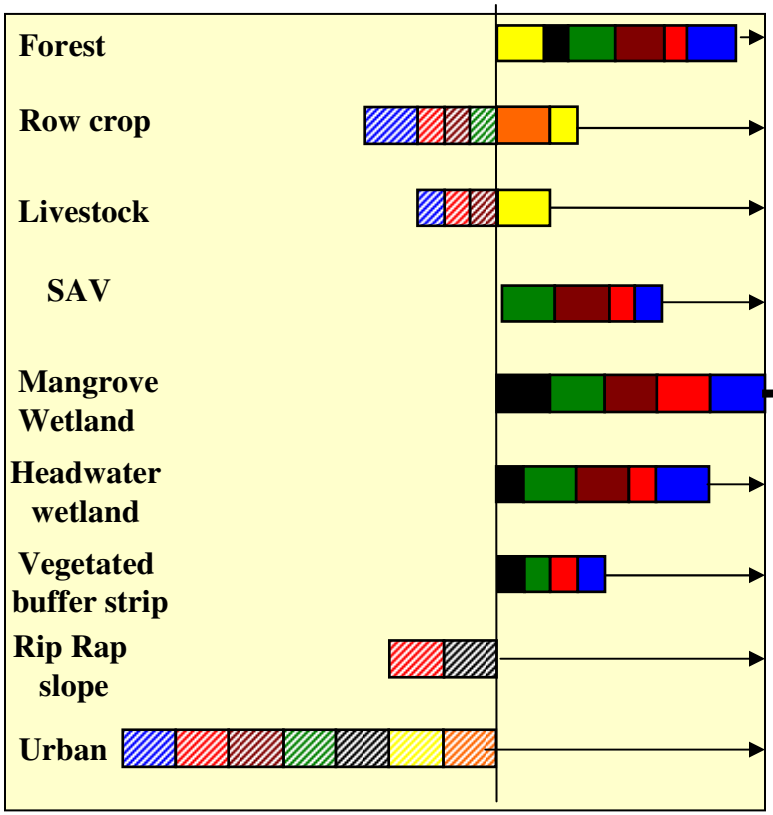
# Hypothetical ecosystem service values:
## *Bundled by land use in the Willamette ESD*




*Relative value could be a rate, say kg/ha/yr, or represent economic or social value.

# End Product

***Relative Ecosystem Services Within an Ecosystem District***




**Scaling and Aggregation Under Alternative Management Scenarios**

Options

A

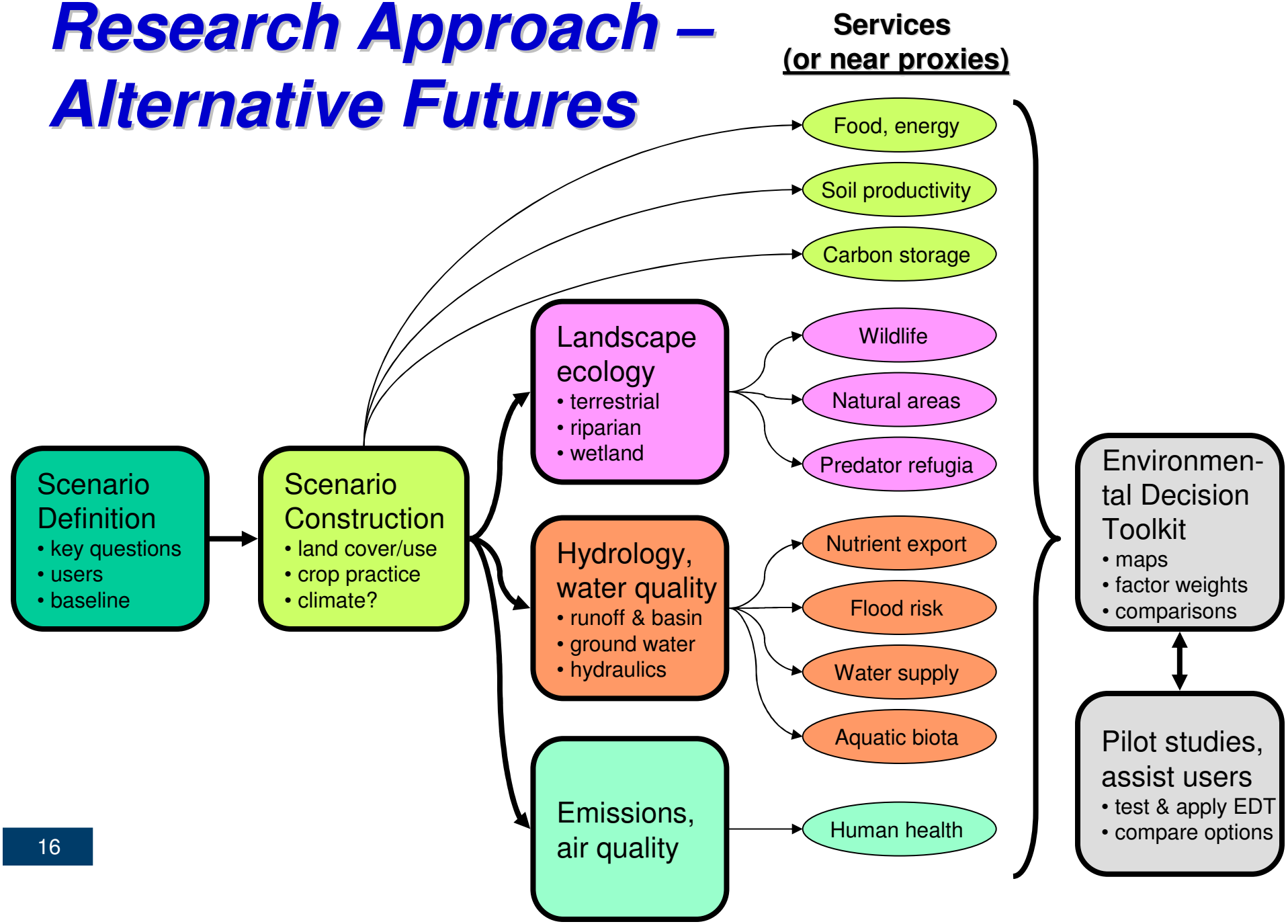
B

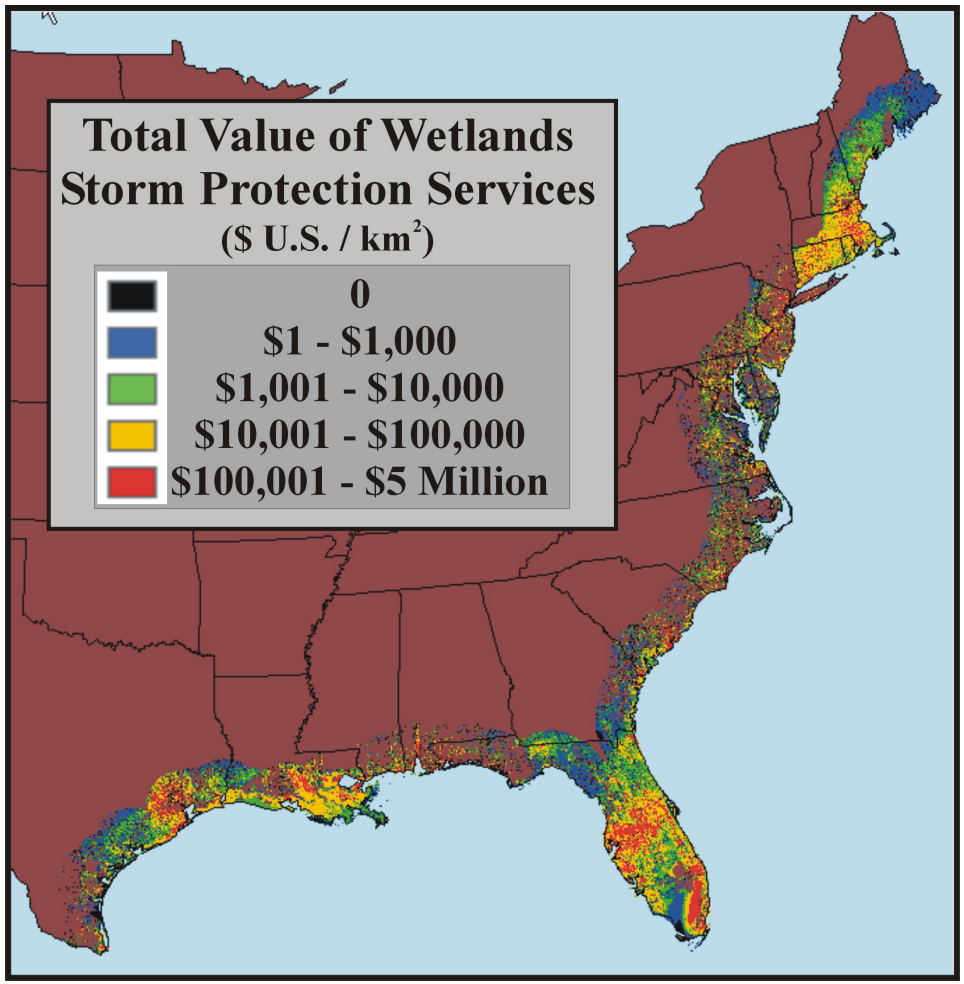
C

**Net Value of Services**

**Management Option X**

# Research Approach – Alternative Futures






Caution, one system, one service approach

**Average value = $8,240/ha/yr**

**Plus, all the other services, plus quality, plus position on the landscape, plus local scales, plus…….other values**

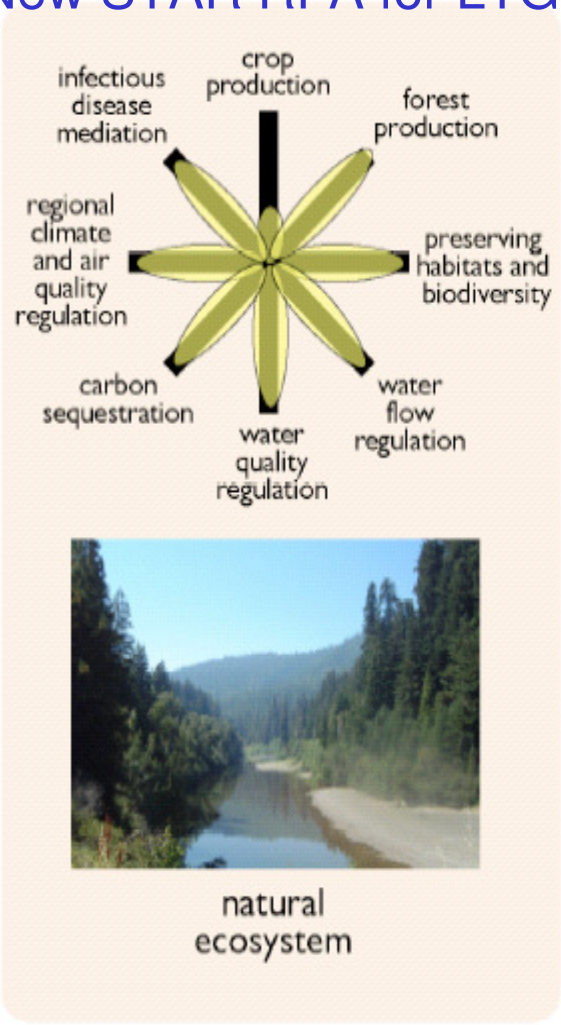


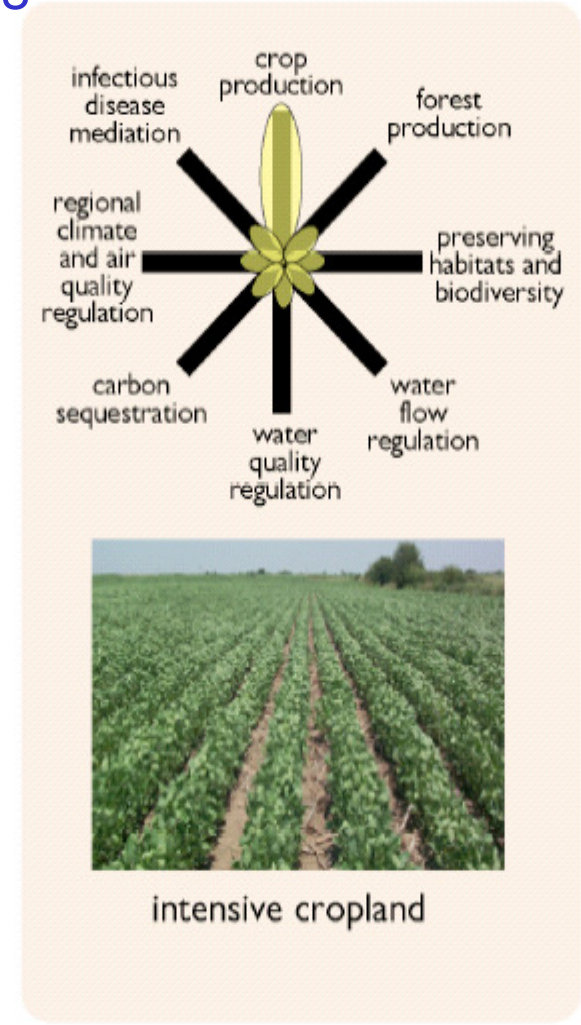


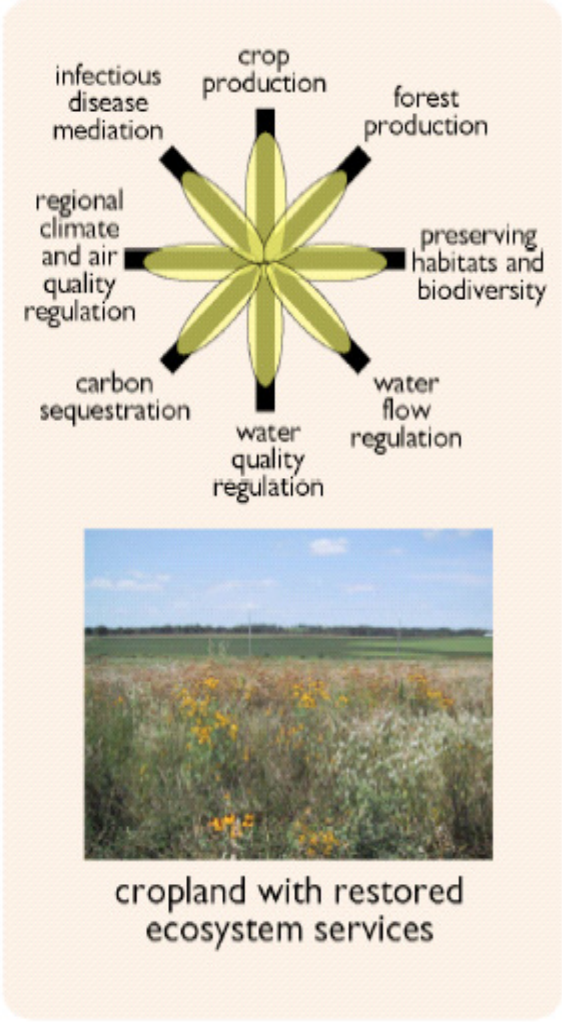
From: Costanza, R., O. Pérez-Maqueo, M. L. Martinez, P. Sutton, S. J. Anderson, and K. Mulder 2007. The Value of Coastal Wetlands for Hurricane Protection. BioScience (in review)

# Enhancing multiple ecosystem services from agricultural lands –

## New STAR RFA for LTG 3




**Hypothetical landscapes and their "production functions:"**

Foley, et al. 2005. Global consequences of land use. Science. 309: 570-574

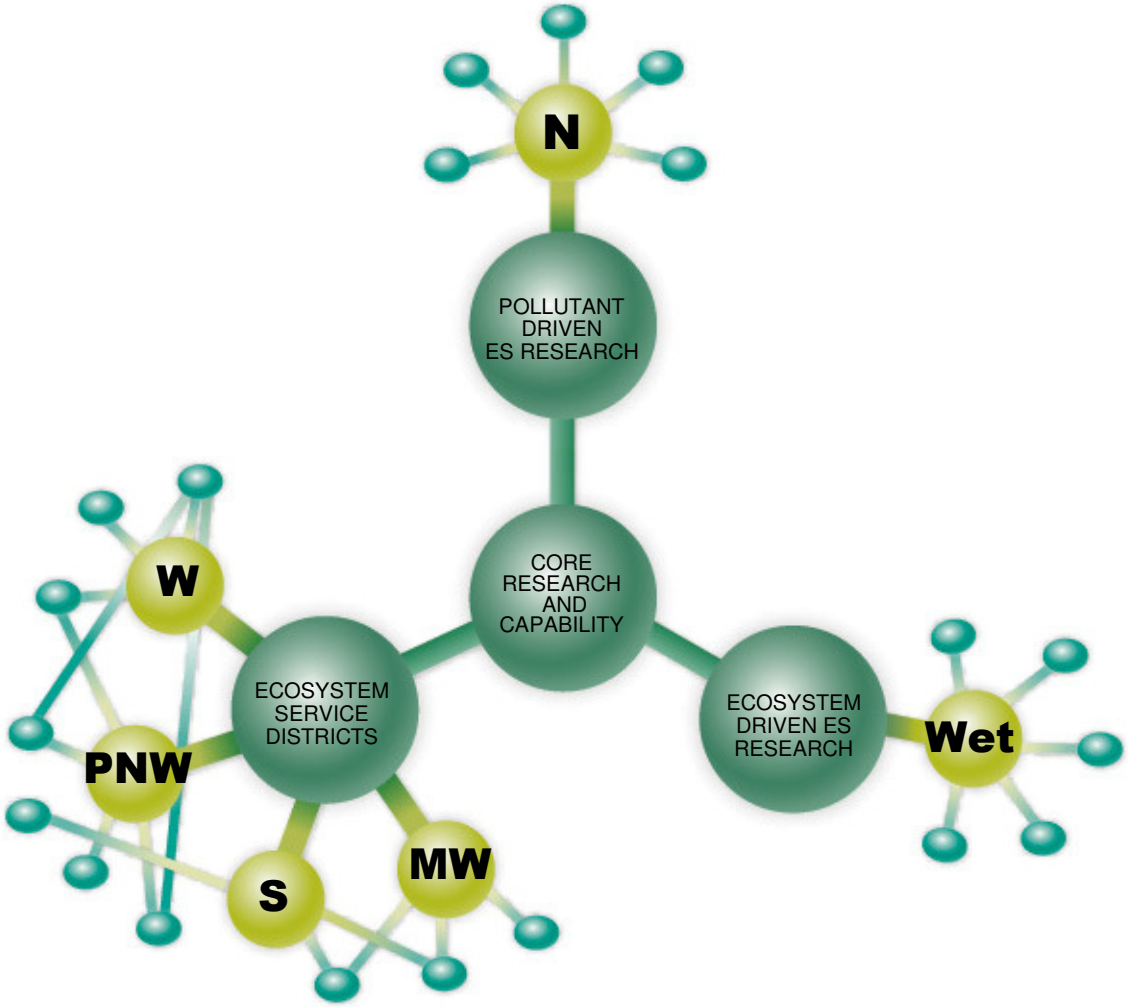
# *Shameless Advertisement*

## ORD Ecological Research Program

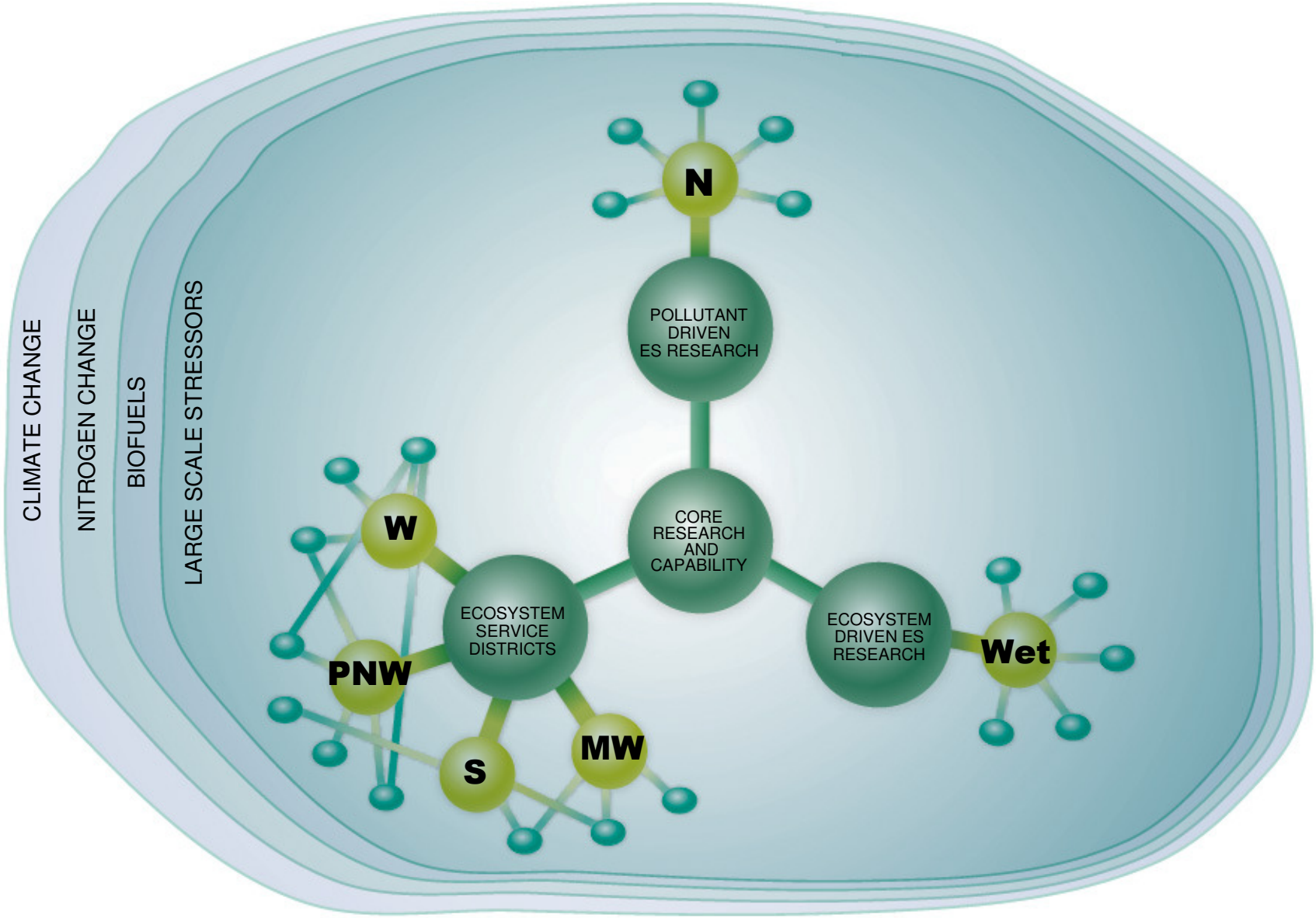
# *Elements: a three prong approach*

- Pollutant Driven Ecosystem Services Research
  - How does a regulated pollutant affect, positively and/or negatively the collection/bundle of ecosystem services at multiple scales?
- Ecosystem Driven Ecosystem Services Research
  - How does the collection/bundle of ecosystem services provided by a single ecosystem type change under alternative management options at multiple scales?
- Place Driven Ecosystem Services Research
  - How do the collection/bundle of ecosystem services for all ecosystems within an ecosystem district change under alternative management options/drivers?

# ECOLOGICAL RESEARCH PROGRAM



# ECOLOGICAL RESEARCH PROGRAM



# *LTG 1: Decision Support Platform*

- By 2014 ORD will provide an innovative online decision support platform that offers EPA, Regions, States, local communities and resource managers the ability to integrate, visualize, and maximize use of diverse data, models and tools at multiple scales to generate alternative decision options and understand the consequences of management decisions on the sustainability of ecosystem services, their value and human well-being.

# *Forecasting Regional vulnerability to stressors: SEQL example: Balancing among competing priorities*

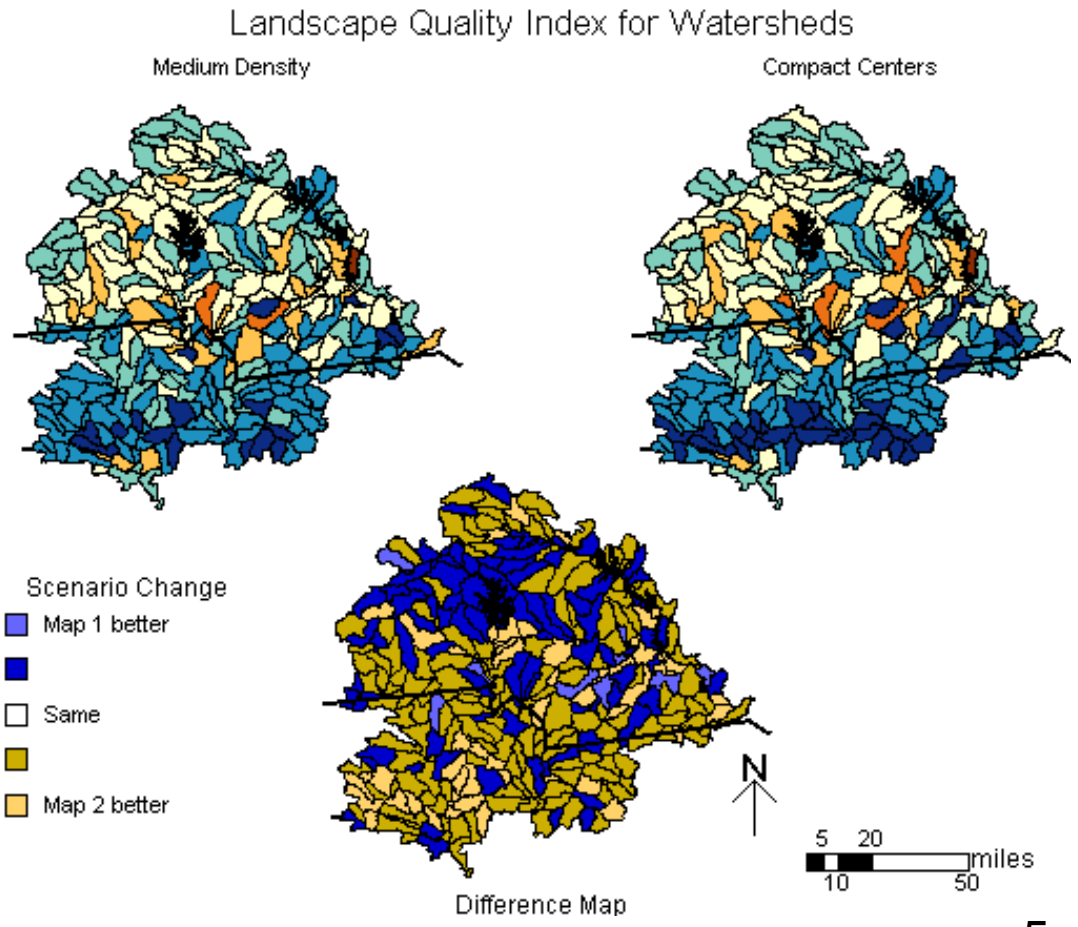
## Outputs/Outcomes

Web-based decision support toolkit with alternative development scenarios projected out to 2030

Decision-makers representing over 100 local jurisdictions in region using toolkit to evaluate trade-offs associated with land use alternatives

## Partners

EPA Office of Air Quality, Planning and Standards, Centralina Council of Governments, Catawba Council of Governments, NC Dept. of Environment and Natural Resources, SC Dept. of Health and Environmental Control, UNC - Charlotte, Duke University, University of Maryland, USGS, TVA



# *LTG 2: National Mapping and Inventory*

- By 2013 ERP will deliver a publicly accessible, scalable, national atlas and inventory system for selected ecosystem services that can be quantified directly or indirectly across the U.S. to be used by the Agency, NGO's, and other decision makers to support prioritizing policy and management actions and their consequences

EPA

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